Electric Program Investment Charge (EPIC)

Second Triennial Investment Plan Cycle

Stakeholder Workshop

March 17, 2014

Pacific Gas and Electric Company

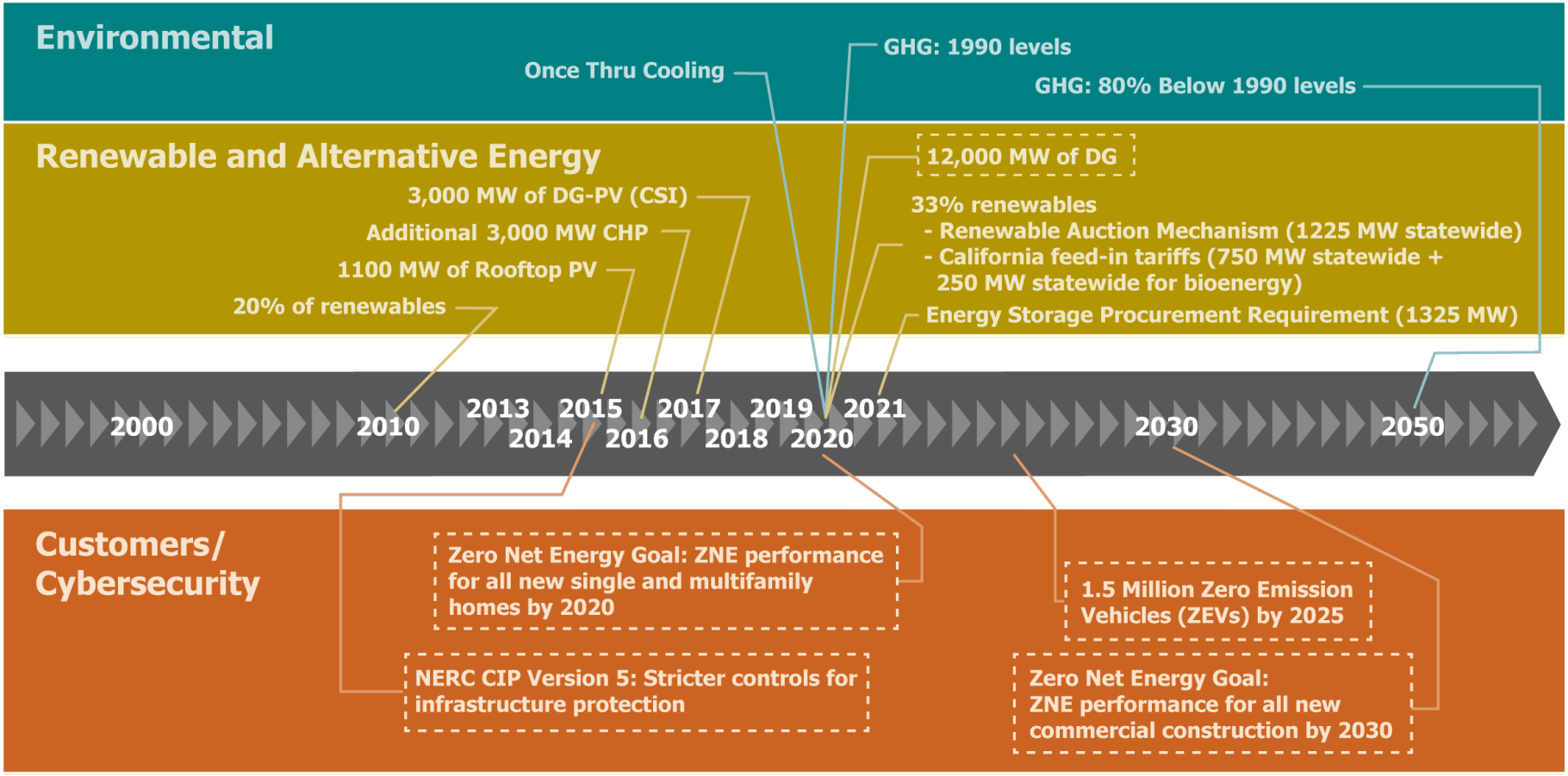
SDGE
A Sempra Energy utility

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

Agenda

- **Investor-Owned Utility Context and EPIC Investment Framework**
  - John Minnicucci, Southern California Edison Company
- **Overview of Southern California Edison Company's 2015-2017 EPIC Investment Plan**
  - Percy Haralson, Southern California Edison Company
- **Overview of Pacific Gas and Electric Company's 2015-2017 EPIC Investment Plan**
  - Suna Taymaz, Pacific Gas and Electric Company
- **Overview of San Diego Gas & Electric Company's 2015-2017 EPIC Investment Plan**
  - Frank Goodman, San Diego Gas & Electric Company
- **EPIC Intellectual Property Discussion**
  - John Minnicucci, Southern California Edison Company
- **EPIC Research, Development & Deployment Journey**
  - Joint IOUs discussion
- **Public Comments and Questions on the Investor-Owned Utility 2015-2017 EPIC Investment Plans**
- **Investor-Owned Utility Contact Information & Written Comments**

A Survey of California's Energy Goals



California Electricity Policy Timeline

LEGEND: **Mandate** **Goal**

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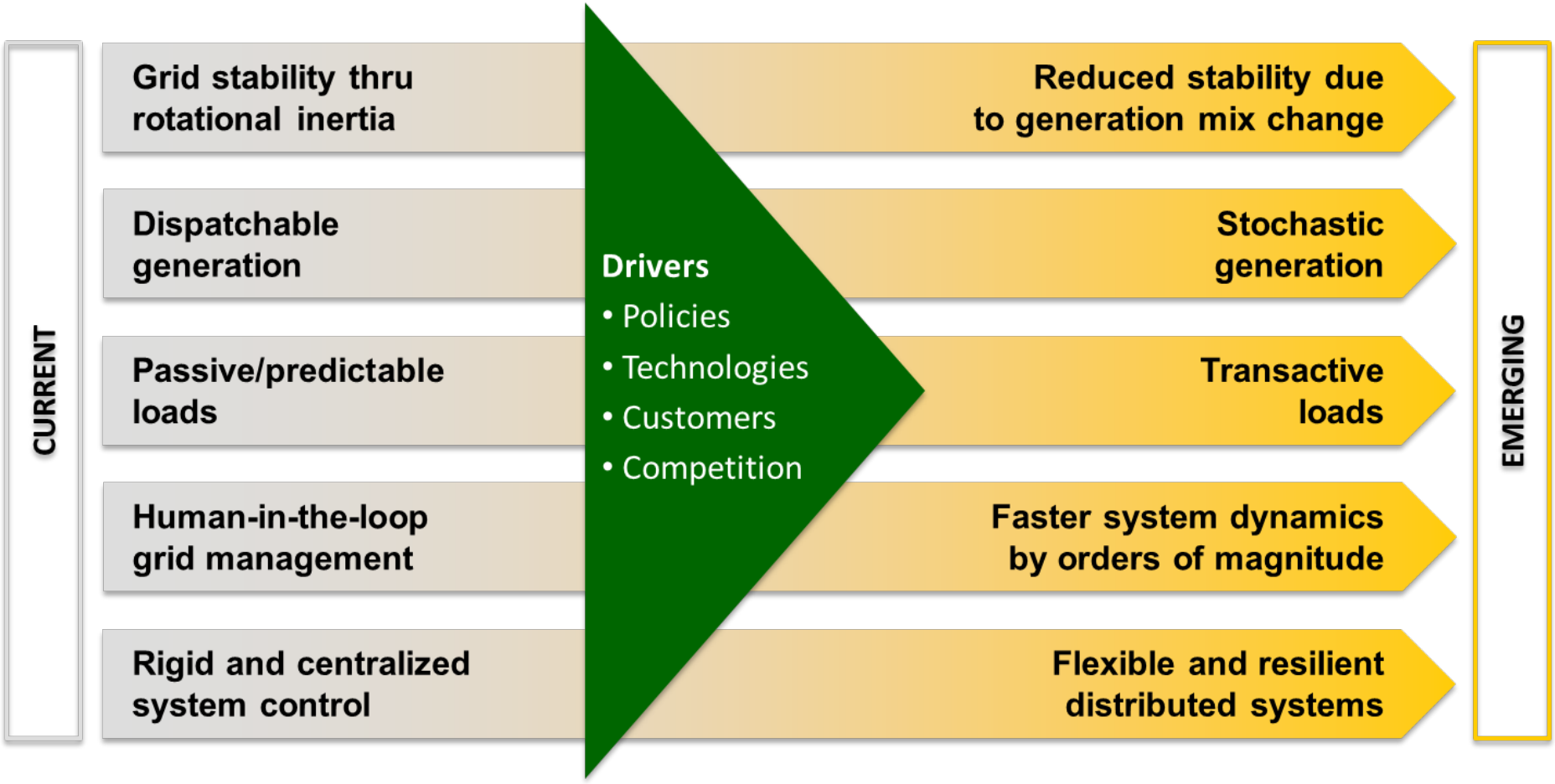
Electric Systems Face Fundamental Changes



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The Electric Program Investment Charge

Funding & Allocation	▪ $162M/yr in ratepayer funding (2013-2020) ▪ CEC administers 80% of the authorized budget; IOUs administer 20%
Approved Investment Areas	▪ Applied Research: $55M/yr (CEC only) ▪ Technology Demonstration & Deployment – CEC $45M, PG&E $15M, SCE $12M, SDG&E $3M (/yr) ▪ Market Facilitation: $15M/yr (CEC only)
Electricity System Value Chain	▪ Grid Ops / Mkt. Design ▪ Generation ▪ Transmission ▪ Distribution ▪ Demand-Side Mgmt

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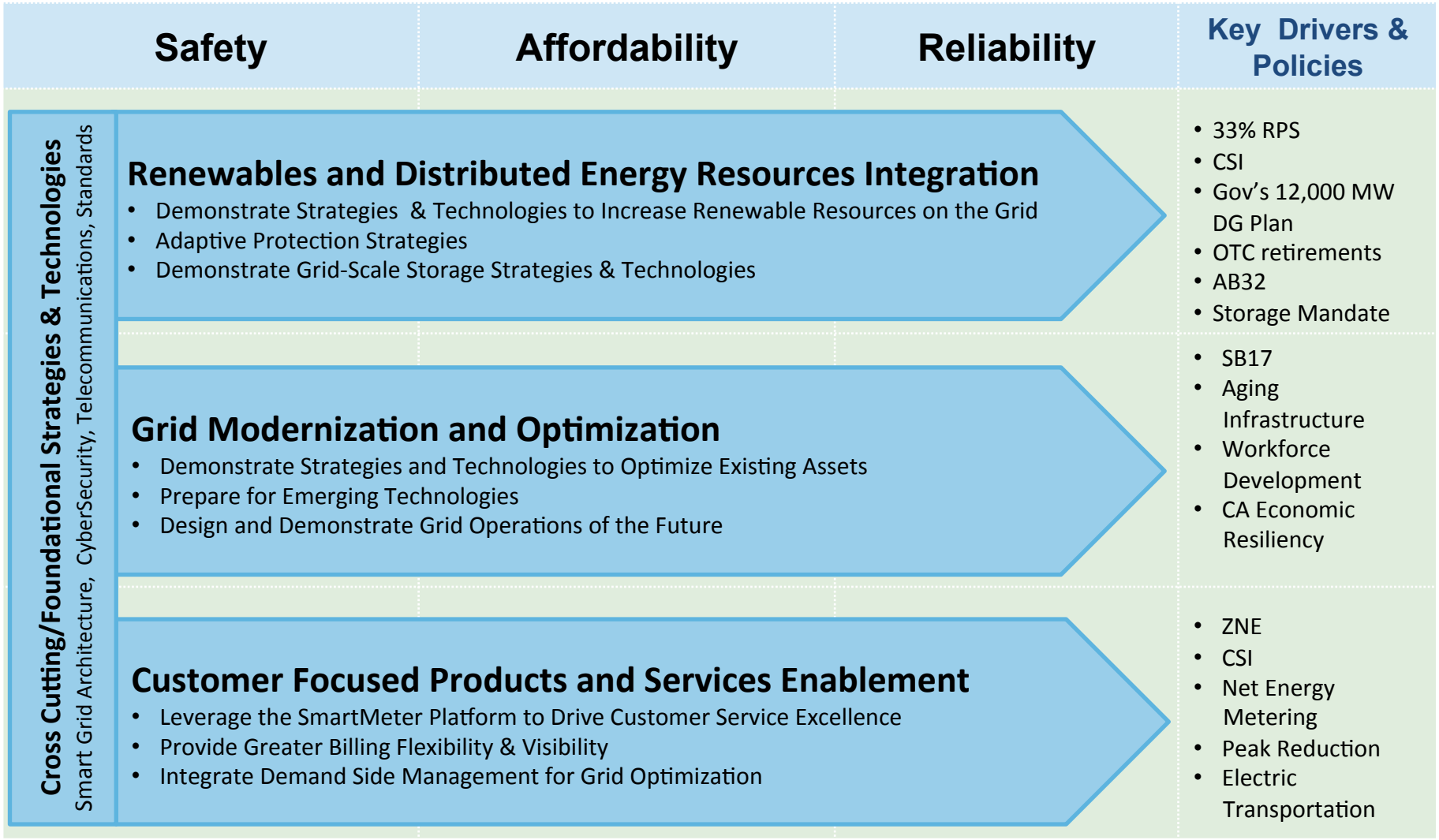
Investor Owned Utility EPIC Framework



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SCE

Presented by

Percy Haralson

Principal Manager, Advanced Technology

SCE's Potential Demonstration Projects

Renewables and Distributed Energy Resources Integration

- *Dynamic Distribution Circuit Configuration for Storage Siting*
- *Optimized Control of Multiple Storage Systems*
- *Online Security Assessment Tools Demonstration*
- *Bulk System Restoration Under High Renewable Resources Penetration Demonstration*

Grid Modernization and Optimization

- *System Intelligence & Situational Awareness*
- *Next Generation Distribution Automation & Equipment*
- *Fast Dynamic Voltage & Frequency Response*
- *Dynamic Power Conditioner*
- *Series Compensation for Load Flow Control*
- *Special Protection Scheme Platform*
- *Proactive Storm Impact Analysis Demonstration*
- *Advanced Grid Capabilities Using Smart Meter Data*
- *Versatile Plug-in Auxiliary Power System (VAPS)*

Customer Focused Products and Services

- *Regulatory Mandates: Submetering Enablement Demonstration – Phase 2*
- *Integration of Big Data for Advanced Automated Customer Load Management*
- *DC Fast Charging Demonstration*
- *Energy Savings Model Demonstration Using Smart Meter Data*

Cross-Cutting / Foundational Strategies & Technologies

- *Regional Grid Optimization Demonstration*
- *Cyber-Intrusion Auto-Response and Policy Management System (CAPMS)*
- *CAISO Operations & Utility Grid Coordination*
- *Microgrid for Enhanced Grid Reliability & Security*

Optimized Control of Multiple Storage Systems

Renewables and Distributed Energy Resources Integration

Concern, Problem, or Gap to be Addressed –

- Energy storage device deployment is expected to proliferate in response to the CPUC Storage OIR mandate to procure/deploy 580 MW of storage capacity on SCE's system.
- There exists no implementation of a multiple vendor communication and controls standard that can be integrated with grid needs and respond to external system needs.
- Charging/discharging of storage devices can be less than optimal at best if left in autonomous stand-alone modes and can actually be detrimental to the grid conditions at worst if not run and directed optimally as determined by the state estimation of the distribution system.

Technology or Strategy to be Demonstrated –

Demonstrate the ability of multiple energy storage controllers to integrate with SCE's Distribution Management System (DMS) and other decision making engines to realize optimum dispatch of real and reactive power based on grid needs. The controllers and their integration with hierarchical systems will result in multiple control strategies including responding to local circuit needs, and responding to volt/VAR optimizations schemes. This demonstration will seek to optimize multiple functional requirements and attempt to execute an optimum control strategy based on grid conditions and external events.

EPIC Primary or Secondary Principles Met

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies

Versatile Plug-in Auxiliary Power System (VAPS)

Grid Modernization & Optimization

Concern, Problem, or Gap to be Addressed –

- Fleet vehicles are typically parked and left idling while small generators are used to support the essential safety gear, radios, tools and equipment of the work site. The result is excess fuel consumption, emissions, noise, and wear and tear on engines.
- With the VAPS system, all those engines are turned off, and the built in battery runs the loads all day.

Technology or Strategy to be Demonstrated –

This project demonstrates the electrification of transportation and vocational loads that previously used internal combustion engines powered by petroleum fuels in the SCE fleet. The VAPS system uses automotive grade lithium ion battery technology (Chevrolet Volt and Ford Focus EV) which is also used in notable stationary energy storage projects (Tehachapi 32 MWh Storage). The power from the battery goes into an inverter and a DC-DC converter to provide both AC and DC power needs. Intelligent system controls manage the battery under all operating conditions of charge, discharge and system diagnostics. In addition, this project will investigate the applicability of secondary usage of previously used cells, as this application is conducive to that usage; this may increase the life cycle value of li-ion cells, prior to their disposal. Finally, this technology will demonstrate other uses of this power system as a stand-alone energy resource, where fossil fuel powered generators are typically used.

EPIC Primary or Secondary Principles Met

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies

Cyber Auto-Response and Policy Management System

Cross Cutting/Foundational Strategies and Technologies

Concern, Problem, or Gap to be Addressed –

- Many cyber attacks are executed in time frames beyond the ability of a human operator to observe, asses, respond and reconfigure the cyber security system and protect the electric system it secures.
- This project will demonstrate automated actions that can protect the electric grid from fast, automated cyber attacks.

Technology or Strategy to be Demonstrated –

This project will demonstrate the ability of SCE's common cyber security services (CCS) to support cyber-intrusion auto-response and policy management for distribution and critical infrastructure protection. Specifically, this system will demonstrate the effectiveness of cyber security software and system configurations to automatically detect a cyber-attack and take automated action to protect the electric system through the enforcement of advanced cyber security devices. The project will deploy these policies on utility equipment (e.g., digital fault recorders, smart inverters, and relays). The technology and strategies used in this system will demonstrate the effectiveness of transferring advanced military-grade cyber security technology onto the electric grid.

EPIC Primary or Secondary Principles Met

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies

CAISO Operations & Utility Grid Coordination

Cross Cutting/Foundational Strategies and Technologies

Concern, Problem, or Gap to be Addressed –

- Independent System Operators and Regional Transmission Operators tasked with balancing generation with load and managing the dispatch of supporting ancillary services in operating wholesale electric markets have limited visibility of and access to smaller-scale California preferred resources
- There is currently no mechanism or design for establishing hierarchical access to effectively coordinate these resources between a Distribution System Operator (SCE) and a Wholesale Market operator (CAISO)

Technology or Strategy to be Demonstrated –

This project will demonstrate Utility/Distribution System Operator facilitated access to customer resources. Specifically, the California ISO (CAISO) will send a signal to Southern California Edison (SCE) that will be interpreted into a grid state that reflects the level of need to dispatch signals for customer-owned resources such as load controlling devices, energy storage devices and distributed generation. The signals may include prices, controls or grid state signals that invoke a response from preferred resources in support of the transmission and distribution system reliability. This project is intended to be a technology and communications focused demonstration in support of enhanced grid reliability. It is not a demand response program.

EPIC Primary or Secondary Principles Met

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies

Microgrid for Enhanced Grid Reliability & Security

Cross Cutting/Foundational Strategies and Technologies

Concern, Problem, or Gap to be Addressed –

- Adverse effects of natural disaster and unforeseen occurrences such as earthquakes, windstorms, fires, vandalism, and intentional sabotage pose a threat to grid resiliency and security.
- There are no system standards to implement microgrids. Some microgrid technologies have been piloted, but are still widely experimental and few to none commercial implementations exist today.

Technology or Strategy to be Demonstrated –

This project will demonstrate advanced commercial-grade microgrid controllers capable of managing/controlling microgrid systems consisting of between 1 and 10 megawatts (MW) of aggregated generation capacity. The project will evaluate microgrid's effectiveness for energy resilience (including protection of critical infrastructure and public resources). The focus will be on strengthening the resilience of electrical infrastructure against adverse effects of natural disaster and other unforeseen occurrences such as earthquake, windstorm and hurricane. This project will also evaluate an advanced control system, potentially consisting of multiple components and subsystems, capable of sensing grid conditions, and monitoring and controlling the operation of a microgrid during all microgrid operating modes (grid-connected, islanded, and transition between the two). It will demonstrate microgrids with various load-block sizes (community microgrid vs. mini-microgrid) to determine the most desirable configurations. SCE plans to leverage other sources of funding such as Department of Energy (DOE).

EPIC Primary or Secondary Principles Met

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies

Pacific Gas and Electric Company®

PG&E

Presented by

Suna Taymaz

Sr. Manager Smart Grid and R&D
Program Management Office

Pacific Gas and Electric Company®

PG&E's Potential Demonstration Projects

PRELIMINARY DRAFT

Renewables and Distributed Energy Resources Integration

- *Smart Inverter Capabilities*
- *Demonstrate Distributed Generation visibility, monitoring & tracking for grid integration*
- *Evaluating storage on the distribution grid*
- *Test & Pilot Distribution Energy Management System (DERMS) control & coordination systems*
- *Demonstrate Demand Side Management (DSM) integration into Distribution Reliability and Capacity planning*

Grid Modernization and Optimization

- *"Smart" monitoring and analysis tools for real time asset management*
- *Demonstrate the "Substation of the Future"*
- *Emergency Preparedness Modeling & Emergency Management Mobile Applications*
- *Pilot new mobile technology & visualization applications for the field force & emergency responders*

Customer Focused Products and Services

- *Demonstrate demand-side strategies & technologies to address local and flexible resource needs*
- *Real-time energy usage feedback for customers*
- *Home Area Networks (HAN) for commercial customers*
- *Use data analytics & technology to achieve targeted demand reduction to delay or defer localized capacity upgrades*

Cross-Cutting / Foundational Strategies & Technologies

- *Licensed Spectrum AMI Communications*
- *Open Architecture Devices on the Advanced Metering Infrastructure (AMI) IPv6 network*
- *Next Generation AMI Network Management System*
- *Energy Management Systems and Cybersecurity Integration*

Concern, Problem, or Gap to be Addressed –

- Well-defined strategy, tools and processes for effective storage deployment do not yet exist
- Storage sites at undesirable locations can lead to potential grid problems or higher costs at a later stage
- Grid interaction standards and/or requirements, and "scoring" of storage to compare benefits across storage projects is not well defined

Technology or Strategy to be Demonstrated –

- This project would help develop methodology and techniques to identify and enhance the energy storage deployment on the distribution system (storage types, size, location, grid interaction requirements & best practices)
- Develop systematic processes, analytical tools & evaluation methods to identify locations for energy storage deployment and inform simplified future energy storage resource interconnection

EPIC Primary or Secondary Principles Met -

- ✓ Increased Reliability
- ✓ Affordability
- ✓ Policy Attainment

Emergency Preparedness Modeling & Emergency Mgmt. Mobile Apps

Grid Modernization & Optimization

PRELIMINARY DRAFT

Concern, Problem, or Gap to be Addressed –

- Opportunity to improve understanding of potential damage to the electric system caused by natural hazards (e.g. earthquakes, tsunamis, flooding, wildland fires)
- Improve ability to identify areas with greatest potential of future outages and proactively address
- Improved knowledge of likely damage from actual events will enhance rapid response, and ensure the necessary restoration support is available

Technology or Strategy to be Demonstrated –

- Develop a comprehensive Natural Hazard Damage Model & Tool which could provide the ability to quickly estimate the impacts of any natural hazard (e.g., earthquake, tsunami, flooding, rising sea levels, wildland fires) on utility facilities
- Develop dashboarding/ visualization tools to proactively model Natural Hazards & the impacts to understand vulnerabilities and restoration requirements
- Mobile applications for employees, first responders & the public to enhance Emergency Response during major events

EPIC Primary or Secondary Principles Met -

- Increased Safety
- Increased Reliability
- Societal benefits

Concern, Problem, or Gap to be Addressed –

- Analysis of customers loads during Demand Response (DR) events suggests that there is opportunity to improve volume and consistency of customer response
- Customers may be "better performers" during DR events when they have real-time or near-real-time performance and/or impact feedback

Technology or Strategy to be Demonstrated –

- Evaluate innovative and cost-effective data analytics, strategies & technologies to allow customers to fully participate and improve performance in DR events
- Testing behavioral strategies leveraging customer data access to help customers succeed on optional rates
- "Real time" feedback strategies could include gamification strategies, specific messages or other options that positively impact performance "success"

EPIC Primary or Secondary Principles Met -

- ✓ Increased Reliability
- ✓ Affordability
- ✓ Societal benefits
- ✓ Policy Attainment

Concern, Problem, or Gap to be Addressed –

- Current US Advanced Metering Infrastructure (AMI) networks are largely dominated by unlicensed spectrum
- New vendors have developed technologies offered on licensed spectrum networks that claim benefits to potentially be more flexible, reliable, cost efficient, and secure
- The spectrum landscape continues to evolve; different options and challenges are emerging

Technology or Strategy to be Demonstrated –

- Demonstration would seek to evaluate these licensed spectrum providers not yet widely tested or adopted to evaluate the benefits compared to existing infrastructure
- Demonstrate differing technology options to provide for future envisioned traffic for Smart Grid Communications and Customer Services

EPIC Primary or Secondary Principles Met -

- Increased Reliability
- Affordability
- Policy Attainment

SDG&E

Presented by

Dr. Frank R. Goodman, Jr.

Team Lead, Power System Technology, Integration, and Customer Systems

Technology Innovation & Development Section

SDG&E Potential Demonstration Projects

PRELIMINARY DRAFT

Renewables and Distributed Energy Resources Integration

- *Modernization of Distribution System and Integration of Distributed Generation and Storage*

Grid Modernization and Optimization

- *Data Analytics in Support of Advanced Planning and System Operations*
- *Monitoring, Communication, and Control Infrastructure for Power System Modernization*
- *System Operations Development and Advancement*

Customer Focused Products and Services

- *Integration of Customer Systems into Electric Utility Infrastructure*

Cross-Cutting / Foundational Strategies & Technologies

- *EPRI and Other Collaborative Programs*

Concern, Problem, or Gap to be Addressed –

- Increased use of distributed generation, storage, and controllable electronic devices in the power system will require more sophisticated infrastructure to successfully operate the power system
- Properly designed infrastructure can also maximize the benefits of coordinated use of these new resources to ratepayers
- Without the improved infrastructure, power system performance could be suboptimal and the quality of service to customers could be compromised.

Technology or Strategy to be Demonstrated –

- Demonstrate advanced infrastructure to enable high performance of the power system and superior service to ratepayers.
- The advanced infrastructure will encompass integrated system solutions which strategically coordinate and dispatch the new resources in an optimal way.
- Best practices will be identified by piloting alternative solutions.

EPIC Primary or Secondary Principles Met --

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies
- ✔ Economic development
- ✔ Reduce GHG Emissions

Concern, Problem, or Gap to be Addressed –

- New devices, such as AMI, synchrophasors and other sensors are being widely deployed in power systems
- The resulting data tsunami is becoming an engineering challenge to manage
- If properly managed, it could vastly improve operational efficiencies with significant resulting ratepayer benefits

Technology or Strategy to be Demonstrated –

- Demonstrate alternative techniques for processing data
- Pilot data analytic solutions for filtering and getting the useful data
- Take into consideration uses of the data, such as predictive maintenance
- Identify appropriate standards and communication protocols that should be developed and/or adopted

EPIC Primary or Secondary Principles Met --

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies

Concern, Problem, or Gap to be Addressed –

- Advanced power system automation will require elaborate monitoring, communication and control infrastructure
- Significant increases in system status information and individual component device status information will be needed
- Preferred subsystems for an overall system-of-systems approach for monitoring and control will need to be identified and piloted

Technology or Strategy to be Demonstrated –

- Pilot alternative subsystem solutions, such DERMS, DRMS, and others
- Demonstrate subsystem integration into a system-of-systems architecture
- Incorporate preferred solutions into an overall advanced distribution management system (DMS) approach

EPIC Primary or Secondary Principles Met --

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies
- ✔ Economic development

System Operations Development and Advancement

Grid Modernization & Optimization

PRELIMINARY DRAFT

Concern, Problem, or Gap to be Addressed –

- System operating practices must be kept current with advancements in power system technology and the mix of devices in the system
- Benefits to ratepayers in containing rate increases and bolstering reliability and power quality can come from updating operating practices to fully capture the benefits on new technology deployed
- Training programs, skill sets, and workforce readiness need to be simultaneously kept current with these changes in operating practices

Technology or Strategy to be Demonstrated –

- Identify solutions to keep operating practices current with system technology changes
- Demonstrate advanced system operating practices, consistent with evolving power system changes and ratepayer needs
- Map the advanced operating practices into identification of appropriate training programs, skill sets, and workforce readiness
- Put procedures in place to keep operating practices current with the system technology after the life of this project

EPIC Primary or Secondary Principles Met --

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies
- ✔ Economic development

Integration of Customer Syst. into Elec. Util. Infrastructure

Customer Focused Products and Services

PRELIMINARY DRAFT

Concern, Problem, or Gap to be Addressed –

- Consumer devices, including distributed energy resources, electric vehicles, AMI, and demand management are being deployed in rapidly increasing numbers by all classes of customers.
- Robust interoperability systems are needed to assure that the customer devices are not in aggregate interfering with overall power system operations.
- Technology solutions are needed to determine the locational value of customer resources and to support dispatch of these resources in a way that maximizes value to all ratepayers.

Technology or Strategy to be Demonstrated –

- Identify alternative solutions for successful customer interoperability with utility systems, working in collaboration with other stakeholders
- Demonstrate promising interoperability systems
- Determine the potential impacts of consumer behavior
- Examine requirements for integration with overall transmission and distribution management systems
- Arrive at best practices

EPIC Primary or Secondary Principles Met --

- ✔ Increased reliability
- ✔ Improved power system performance and lower operating costs
- ✔ Increased safety
- ✔ Efficient use of ratepayer monies
- ✔ Economic development
- ✔ Reduce GHG Emissions

EPIC Intellectual Property (IP) Discussion

SCE issued a request for information to existing and potential EPIC suppliers for engineering and technical services

- Respondents included 16 businesses and five universities
- Concerns generally fall within three topic areas:
  - The treatment of preexisting intellectual property,
  - Retaining the ability to use their developed IP,
  - Indemnity for the State of California

SCE is aggressively pursuing cost share and collaboration with the Department of Energy and others

- There are concerns about how the IP directives in the EPIC Decision may impede efforts to leverage ratepayer funding

The Research, Development, Demonstration and Deployment (RDD&D) Journey

- IOUs are focused on making prudent investments in areas that have the potential to deliver benefits to customers & support California's Energy Policy Goals
  - Demonstration learnings are invaluable, regardless of strategy/ technical "success"
  - Success is also strategy or technology non-viability
- EPIC enhances existing industry and research partnerships & collaboration… A larger RDD&D community benefits our customers, California's economy and the utilities
  - Multiple organizations pursuing RDD&D on similar topics is part of the journey to successful "cross-pollination" and innovation
- IOUs are building capabilities *now* to support successful execution & delivery of the EPIC program
  - RDD&D –and innovation – requires portfolio flexibility and adaptable processes while also implementing strong governance
  - Key need is facilitating & expediting demonstration projects through utility processes (procurement process, IP contracting, project delivery)
- EPIC "output" is the beginning of the journey…Change management, customer & industry adoption and regulation all play a role in successful full scale deployment

"I have not failed. I've just found 10,000 ways that won't work."

Thomas Edison

Pacific Gas and Electric Company

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Stakeholder Questions and Comments

Please submit written comments by March 28, 2014

IOU Contact Information

IOU written comments by March 28, 2014

- **SCE EPIC Information and Contacts**:
  - Website: https://www.sce.com/wps/portal/home/regulatory/epic/
  - Email: SCEEPICProgram@sce.com
- **PG&E EPIC Information and Contacts**:
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